REMARKS

On a preliminary note, Applicants thank Examiner Chen and his Supervisor for the courtesies extended during the Examiner Interview conducted on November 7, 2005. During the Examiner Interview, Applicants discussed claim 1 and U.S. Patent No. 6,878,615 to Tsai et al. ("Tsai") and briefly discussed claim 13. Tsai is a newly cited reference in the rejections of the Final Office Action dated September 12, 2005. The substance of the Examiner Interview is summarized herein below.

Examiner Interview

During the Examiner Interview, Applicants argued that Tsai does not disclose a barrier material that blocks impurity diffusion from an underlying interlevel dielectric into an imaging material, a barrier material that is planar, or a barrier material that is removed. Applicants explained that claim 1 requires "depositing a layer of barrier material that substantially blocks impurity diffusion from an underlying interlevel dielectric into an imaging material." Tsai does not disclose a barrier material that blocks impurity diffusion into an imaging material. Instead, Tsai is directed to a method that prevents via poisoning. Tsai does not address impurity diffusion into an imaging material, at all. Further, Applicants explained claim 1 requires "depositing a layer of barrier material ... on the layer of planarizing material." Therefore, the barrier material is necessarily planar, because the barrier material is deposited on a planarizing material. By contrast, the low-k protection layer in Tsai is not planar, but conformal. Finally, Applicants explained that as required by claim 13, the barrier material is removed from

the etched pattern. Tsai, however, maintains the low-k protection layer in the dual damascene structure. For these reasons, Applicants concluded during the Examiner Interview that Tsai does not compensate for the deficiencies of U.S. Patent No. 6,365,529 to Hussein ("Hussein) and therefore, the claimed invention is patentable over Hussein in view of Tsai.

Status of the Claims

The following remarks have been submitted in consideration of the Final Office Action mailed September 12, 2005. Claims 1-11, 13-27, 29-45, 47-97 remain pending for examination. Claims 1, 15, 33, 52, 66, and 83 are the only independent claims. No new matter has been added.

Rejection of Claims 1-6, 11, 13-18, 24, 27, 29-36, 42, 45, 47-49, 52-57, 62-64, 66-69, and 77-81 under 35 U.S.C. §103(a) over Hussein in view of Tsai

Claims 1-6, 11, 13-18, 24, 27, 29-36, 42, 45, 47-49, 52-57, 62-64, 66-69, and 77-81 stand rejected pursuant to 35 U.S.C. § 103(a) as unpatentable over Hussein in view of Tsai. Applicants respectfully traverse this rejection.

With respect to independent claims 1, 15, and 33, it is a feature of the claimed invention that a barrier layer that substantially prevents diffusion from an interlevel dielectric layer into an imaging is deposited on the layer of planarizing material, it is a further feature of independent claims 1, 15, and 33 that a layer of anti-reflective coating is deposited on said barrier material, and it is another feature of independent claims 1, 15, and 33 that at least one layer of imaging material is deposited on the layer of barrier

material. Applicants respectfully submit that these features (at least) are neither disclosed nor suggested by Hussein.

Tsai does not compensate for the deficiencies of Hussein. Tsai, as discussed herein above, does not disclose "depositing a layer of barrier material that substantially blocks impurity diffusion from an underlying interlevel dielectric into an imaging material on the layer of planarizing material." Tsai is directed to "a method of reducing via poisoning in low-k dielectric materials through the use of a protective metal layer." (Tsai, col. 1, lines 8-10). In Tsai, the protective metal layer is a low-k protection layer (250). (Tsai, col. 6, lines 37-38). Tsai teaches forming a low-k protection layer (250) that prevents outgassing from underlying insulative layers (220) and forming a barrier layer (280) on the vertical walls of said trench opening and on the portion of said low-k protection layer (250) on the vertical walls of said hole opening. (Tsai, Fig. 2i). The combination of the low-k protection layer (250) and the barrier layer (280) provide double protection against via poisoning. (Tsai, col. 7, lines 8-11). Tsai, however, does not teach a method to prevent impurity diffusion into an imaging material.

If Hussein were to be modified to disclose low-k protection layer of Tsai, Hussein would still fail to disclose the claimed invention for the following reasons. Tsai does not teach a barrier material that substantially blocks impurity diffusion from an underlying interlevel dielectric into an imaging material. Neither Hussein nor Tsai recognize the importance of the claimed combination of a barrier material that prevents impurity diffusion into an imaging material. Therefore, the combination of Hussein and Tsai fails to teach the claimed invention.

With respect to independent claims 52 and 66, it is a feature of the claimed invention that a layer of planarizing material is deposited on the thin film, that a barrier material of silicon dioxide is deposited on the planarizing material. Applicants respectfully submit that these features (at least) are neither disclosed nor suggested by Hussein, and further that Tsai does not compensate for the deficiencies of Hussein.

Tsai does not disclose a barrier material of silicon dioxide layer deposited on a planarizing material. As shown in Figure 2c in Tsai, the low-k protection layer (250) is conformally deposited over the substrate and lining of the inner walls of the hole openings. (Tsai, col. 6, lines 33-37). Therefore, Tsai does not disclose a barrier material of silicon dioxide deposited on a planarizing material.

If Hussein were to be modified to disclose low-k protection layer of Tsai, Hussein would still fail to disclose the claimed invention for the following reasons. If Hussein were to be modified, Hussein would still not teach a barrier material of silicon dioxide deposited on a planarizing material. Neither Hussein nor Tsai recognize the importance of the claimed combination of a barrier material of silicon dioxide deposited on a planarizing material that prevents impurity diffusion into an imaging material. Therefore, the combination of Hussein and Tsai fails to teach the features of the invention.

Accordingly, Applicants respectfully submit that independent claims 1, 15, 33, 52, and 66 are patentable over Hussein in view of Tsai and that claims 2-6, 11, 13-14, 16-18, 24, 27, 29-32, 34-36, 42, 45, 47-49, 53-57, 62-64, 67-69, and 77-81 are patentable by virtue of their dependence on an allowable base claim. Applicants respectfully request withdrawal of this rejection against claims 1-6, 11, 13-18, 24, 27, 29-36, 42, 45, 47-49, 52-57, 62-64, 66-69, and 77-81.

Rejection of Claims 7-8, 20-23, 38-41, 58-59, and 71-74 under 35 U.S.C. § 103(a) as unpatentable over Hussein in view of Tsai in further view of U.S. Patent No. 6,391,472 to Lamb III ("Lamb")

Claims 7-8, 20-23, 38-41, 58-59, and 71-74 stand rejected pursuant to 35 U.S.C. § 103(a) as being unpatentable over Hussein in view of Tsai in further view to Lamb. Applicants respectfully traverse this rejection.

Claims 7-8, 20-23, 38-41, 58-59, and 71-74 depend from independent claim 1, 15, 33, 52, and 66 which are patentable for the reasons identified herein above. Lamb does not compensate for the deficiencies of Hussein or Tsai. Lamb does not disclose depositing a layer of barrier material on a layer of planarizing material, that an anti-reflective layer is deposited on the barrier material, and that an imaging layer is deposited on the anti-reflective layer. Lamb further fails to provide any motivation to modify Hussein in view of Tsai in the manner of the claimed invention.

Accordingly, Applicants respectfully submit that Claims 7-8, 20-23, 38-41, 58-59, and 71-74 are patentable over Hussein in view of Tsai in further view of Lamb, and therefore request withdrawal of the rejection.

Rejection of Claims 9-10, 19, 25-26, 37, 43-44, 50-51, 60-61, 65, 70, 75-76, 82-83, and 92-96 under 35 U.S.C. § 103(a) as unpatentable over Hussein in view of Tsai in further view of Wolf, *Silicon Processing for VSLI Era*, vols. 1 and 4, Lattice Press (1986, 2002) ("Wolf").

Claims 9-10, 19, 25-26, 37, 43-44, 50-51, 60-61, 65, 70, 75-76, 82-83, and 92-96 stand rejected under 35 U.S.C. §103(a) over Hussein in view of Tsai in further view of Wolf. Applicants respectfully traverse this rejection.

Claims 9-10, and 50 depend from claim 1, claims 19, 25-26 and 51 depend from claim 15, claims 37 and 43-44 depend from claim 33, claims 60-61, 60, and 65 depend from claim 52, and claims 70, 75-76 and 82 depend from claim 66. For the reasons stated herein above, these dependent claim are patentable by virtue of their dependence on an allowable base claim.

Further, with respect to claims 9-10, 25-26, 43-44, 60-61, and 75-76, Applicants note that it is a feature of the claimed invention that "the barrier material comprises silicon dioxide deposited by plasma-enhanced chemical vapor deposition at a temperature of 100°C to about 225°C." As mentioned herein above, neither Hussein nor Tsai teaches a barrier material that blocks impurity diffusion from an underlying interlevel dielectric into an imaging material. Wolf does not compensate for Hussein and Tsai's deficiencies.

Wolf is directed to silicon processing. More specifically, Wolf teaches PECVD of silicon dioxide at a temperature of 200°C. Wolf however does not disclose a barrier material that blocks impurity diffusion from an underlying interlevel dielectric into an imaging material. For this reason (at least) Wolf does not compensate for the deficiencies of Hussein and Tsai.

If Wolf were to be combined with Tsai, Tsai would no longer work for its intended purpose which is to prevent via poisoning during high temperature processing. (Tsai, col. 5, lines 39-52). Tsai teaches a low-k protection layer that prevents via poisoning during high temperature processing. (Tsai, col. 5, lines 39-41). More specifically, the high temperature processing in Tsai occurs between 350 to 450°C. (Tsai, col. 5, lines 59-63). For this further reason, the claimed invention is patentable over the combination of Hussein in view of Tsai in further view of Wolf.

None of the prior art references teach a barrier material that both blocks impurity diffusion from an underlying interlevel dielectric into an imaging layer, while avoiding damage to the planarizing layer upon which the barrier material is deposited. As stated in ¶18 of the specification, the barrier layer is "preferably a low temperature oxide (LTO) film." Further as stated in ¶26 of the specification, "although LTO deposited by PECVD is preferred, other materials may be used for the diffusion barrier layer 17 so long as their deposition temperature and stress are suitably low to avoid damaging of the planarizing layer." For this further reason, the claimed invention is patentable over the combination of Hussein in view of Tsai in further view of Wolf.

With respect to claim 83, which is the only independent claim recited in this rejection, it is a feature of the claimed invention that a layer of planarizing material is deposited on a dielectric material, a barrier material of silicon dioxide is deposited on the planarizing material, and the barrier material is removed. Applicants respectfully submit that these features (at least) are neither disclosed nor suggested by Hussein, and further that Tsai does not compensate for the deficiencies of Hussein. As discussed herein above, the low-k protective layer (250) is not removed in Tsai. Wolf also does not teach

removal of a barrier material that is deposited on a planarizing material. For this reason (at least), claim 83 is patentable over the combination of Hussein in view of Tsai in further view of Wolf. Claims 84-87, and 92-96 depend from claim 83, and are allowable by virtue of their dependence on an allowable base claim.

Accordingly, Applicants respectfully submit that 9-10, 19, 25-26, 37, 43-44, 50-51, 60-61, 65, 70, 75-76, 82-83, and 92-96 are patentable over Hussein in view of Tsai in further view of Wolf, and therefore request withdrawal of the rejection.

Rejection of Claims 88-91 under 35 U.S.C. §103(a) as being unpatentable over Hussein in view of Tsai in further view of Wolf and even further view of Lamb

Claims 88-91 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Hussein in view of Tsai in further view of Wolf and even further view of Lamb. Applicants respectfully traverse this rejection.

Claims 88-91 depend from claim 83. As stated herein previously above, it is a feature of claim 83 that a layer of planarizing material is deposited on a dielectric material, a barrier material of silicon dioxide is deposited on the planarizing material, and the barrier material is removed. Applicants respectfully submit that these features (at least) are neither disclosed not suggested by the combination of Hussein in view of Tsai and further that neither Wolf nor Lamb compensates for Hussein or Tsai's deficiencies. Therefore, Applicants respectfully submit that claim 83 is allowable, and that claims 88-91, which depend from claim 83, are allowable by virtue of their dependence on an allowable base claim.

Accordingly, Applicants respectfully submit that Claims 88-91 are patentable over Hussein in view of Tsai in view of Wolf in even further view of Lamb, and therefore request withdrawal of this rejection.

Conclusion

Applicants respectfully submit that claims 1, 15, 33, 52, 66, 83 are allowable and claims 2-11, 13-14, 27, 16-27, 29-32, 34-45, 47-51, 53-65, 67-82, 84-97 are similarly allowable by virtue of their dependence on an allowable base claim. For the foregoing reasons, it is respectfully submitted that the present application is in condition for allowance.

Reconsideration and allowance of pending claims is respectfully requested.

Respectfully Submitted,

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